Presentation and item analysis of the IE-ACCME-B Test for measuring emotional and meta-emotional intelligence in children

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A R T I C L E I N F O

A B S T R A C T

- This paper aims to present the initial findings and item analysis of the IE-ACCME-B test, a multi-method assessment tool specifically developed for evaluating emotional and meta-emotional intelligence in children aged 8 to 11 years. The IE-ACCME-B test was designed within the framework of the meta-emotional intelligence construct and has a dual purpose: 1) measuring emotional intelligence, defined as the ability to perceive, facilitate, understand, and manage emotions, and 2) assessing meta-emotional intelligence, which involves the belief system regarding emotions and awareness of one's own emotional abilities in perceiving, facilitating, understanding, and managing emotions. The analysis of results and items was conducted using CUB models and by examining children's consensus scores.

1. Introduction

The measurement of emotional intelligence (EI) has garnered significant interest in recent years due to numerous studies highlighting its importance across various aspects of individuals' lives (Fernández-Berrocal & Extremera, 2016; MacCann et al., 2020; Resurrección et al., 2014). However, there remains considerable debate regarding the optimal strategies for measuring emotional intelligence.

According to Mayer et al. (2016), EI represents a form of intelligence reflecting individuals' abilities in emotional problem-solving tasks and their processing of emotional information. They advocate for the measurement of ability-EI using performance tests and developed the Mayer-Salovey-Caruso Emotional Intelligence Test (MSCEIT; Mayer et al., 2002), which assesses emotional problem-solving across various domains. Conversely, proponents of mixed EI models (Bar-On, 1997, 2004; Goleman, 1995) or trait EI models (Petrides et al., 2007; Petrides et al., 2016) view EI as a combination of traits, competencies, and skills measurable through self-report tools. Another group of assessment scales employs self-report methodologies but aligns with the ability model of EI (Brackett et al., 2006; Kirk et al., 2008; Schutte et al., 1998). These differing theoretical models and methodological approaches to measuring EI have led to challenges regarding convergent and divergent validity, as scores from performance tests and self-report measures often show weak or no correlation (Brackett et al., 2006; Brackett & Mayer, 2003; O'Connor et al., 2019), even when based on the same underlying theory.

However, it has been emphasized the importance of assessing both ability-EI using performance tests and self-perceived emotional skills using self-report scales (D'Amico, 2018). Performance tests measure specific skills in emotional problem-solving tasks, self-report scales capture individuals' perceptions of their emotional abilities in daily life, which often drive behaviors and choices more than actual abilities. Building upon this perspective, D'Amico (2018) further explored EI from a metacognitive standpoint (Flavell, 1979) and introduced the construct of meta-emotional intelligence (MEI). MEI encompasses both cognitive-emotional abilities and metacognitive processes influencing emotional life, such as awareness of one's emotional abilities and beliefs about emotions (D'Amico and Geraci, 2023).

To operationalize MEI, the IE-ACCME test (D'Amico, 2013) was developed as a multi-method tool for preadolescents and adolescents, incorporating both self-report and performance measures. This approach allows for a comprehensive assessment of EI skills and self-

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perceived emotional skills, as discrepancies between self-assessment and performance test scores provide insight into individuals' metacognitive awareness of their EI. The IE-ACCME test has demonstrated structural validity and utility in predicting individual differences in psychological dimensions among preadolescents and adolescents. For instance, adolescents with accurate meta-emotional knowledge and self-evaluation are more accepted by their peers, while preadolescents' psychological well-being is linked to their meta-emotional beliefs (D'Amico & Geraci, 2021). Furthermore, MEI offers a framework for examining sex differences in EI, with girls generally exhibiting higher levels of meta-emotional beliefs and performance on emotional abilities tests compared to boys (D'Amico & Geraci, 2022a). These findings underscore the importance of studying MEI variables in younger children, particularly given the ongoing debate surrounding the nature-nurture origins of sex differences in the emotional sphere.

In light of these findings, it is important to develop a tool for measuring EI and MEI in children, recognizing the need for age-appropriate assessments. Currently, existing scales for children younger than ten primarily adhere to trait (Bar-On & Parker, 2000; Mavroveli et al., 2008) or ability EI models (Mayer et al., 2014; Sastre et al., 2019), with limited coverage of meta-emotional processes, or are based on alternative theoretical frameworks (e.g., DANVA-2 by Nowicki, 2013 and LEAS-C by Bajgar et al., 2005).

Thus, the aim of the present study was to introduce and conduct the initial qualitative item analysis of the IE-ACCME-B test, a novel assessment tool designed for measuring EI and MEI in children approximately aged 8 to 10 years. To achieve this dual objective of qualitatively examining children's responses and performing item analysis, we employed CUB models, a class of models well-suited for analyzing ordinal scales. Additionally, we examined the consensus score for each item of the emotional abilities test.

2. Method

2.1. Participants

A sample of 400 children, aged between 8 and 10 years, and attending the fourth grade of primary school, were recruited from schools in five Italian cities: Bari, Cagliari, Palermo, Rome, and Turin. Initial data collected were subjected to analysis and preprocessing to exclude cases with significant missing data, children with certified intellectual disabilities, specific learning disorders, or general difficulties identified by teachers during test administration. Following these preliminary analyses, a final sample of 364 children (170 males, 194 females) was obtained, with nearly equal distribution across the five cities: 61 in Palermo, 86 in Bari, 68 in Cagliari, 71 in Rome, and 78 in Turin.

2.2. The IE-ACCME-B test presentation

Similar to the IE-ACCME test (D'Amico, 2013), the IE-ACCME-B test is a multi-method assessment tool designed to quantitatively measure distinct aspects of Emotional Intelligence (EI) based on the four-branch
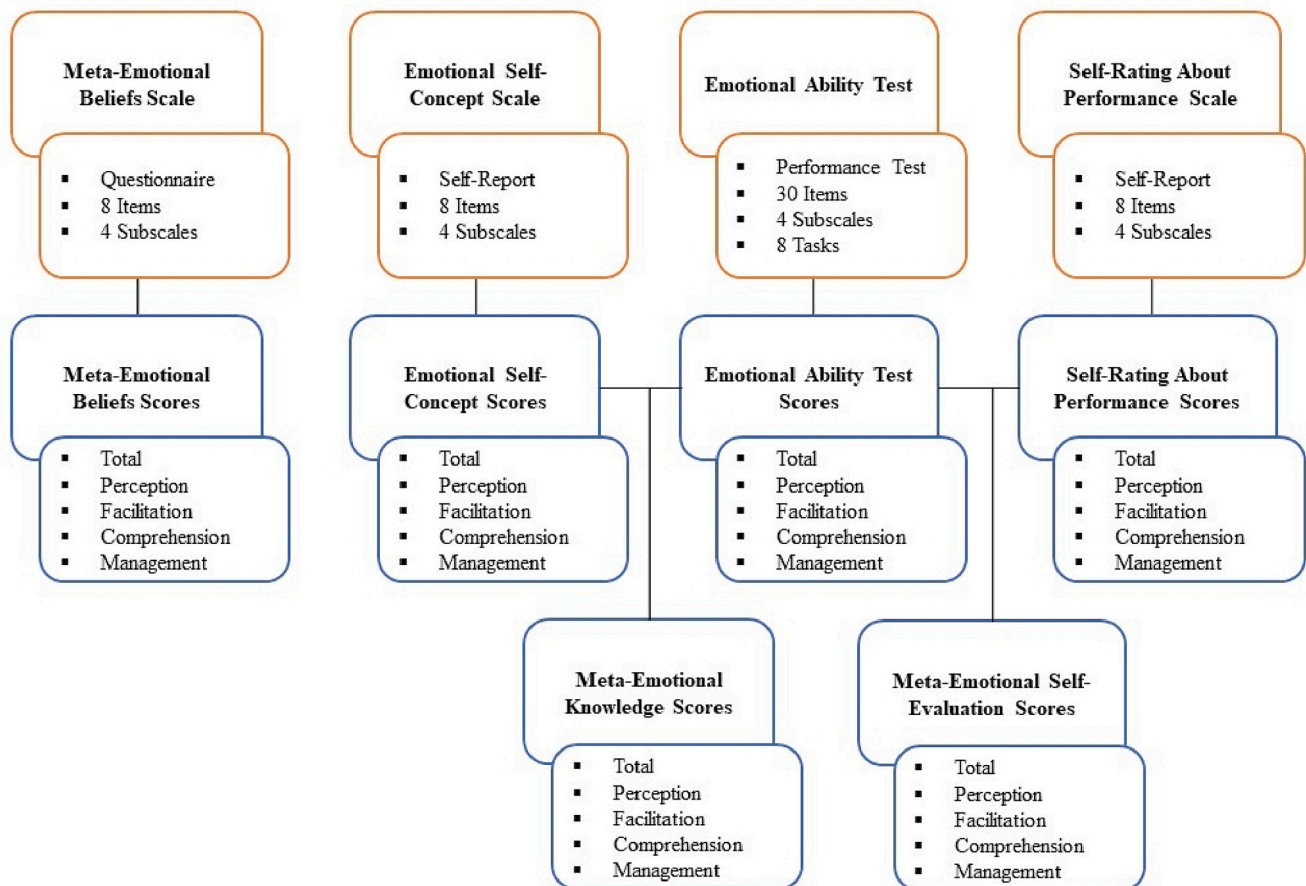

Fig. 1. The IE-ACCME-B Test structure. Orange boxes represent the scales whereas blue boxes represent the scores. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

structure ability model (Mayer et al., 2016). These branches include Perception, Use, Understanding, and Management of Emotions. The test comprises four different scales aimed at measuring meta-emotional beliefs, emotional self-concept, ability-EI, and self-assessment of performance. Once standardization is completed, the standardized scores of the latter three scales will be used to derive scores for meta-emotional knowledge and meta-emotional self-evaluation. The structure of the test, along with one example item for each task, are provided in Figs. 1–4. The complete test in the Italian language is available upon request for use, translation into other languages, and further investigations by contacting the corresponding author.

In developing the IE-ACCME-B test, three main aspects were considered to enhance children's comprehension: 1) almost each item is accompanied by a drawing representing the concept described in the sentence; 2) all sentences are kept as short as possible; 3) high-frequency words are used throughout. Additionally, to facilitate identification with the protagonists in various situations, two forms of the test have been created—one tailored for girls and one for boys. While the two forms share the same content, they use gender-specific pronouns and may occasionally feature different images.

The items in the IE-ACCME-B test version are notably distinct from those in the adolescent version, although the tasks exhibit a similar structure.

Upon beginning the test, children are first presented with the Metaemotional Beliefs Scale (CE scale), where they respond to questions such as "What do you think about emotions?" (Fig. 2). This scale consists of eight items that explore children's beliefs about perceiving,

(a)

(b)

Fig. 2. Examples of Face task items drawn from: (a) CE scale and (b) CME scale. The items have been translated from Italian to English only for dissemination purposes.

facilitating, comprehending, and managing emotions, with responses provided on a four-point Likert scale (i.e., not at all, a little, enough, a lot). High CE scores indicate that children attach significant importance to the emotional dimension in their daily lives and are confident in their ability to perceive and manage emotions. These scores suggest that children believe emotions can facilitate thinking processes, recognize a connection between situations and emotions, and understand that multiple basic emotions can combine to form more complex emotional states.

The second scale presented is the emotional self-concept scale (CME scale), which asks children to rate their abilities to perceive, use, understand, and manage emotions in everyday life (Fig. 2). This scale also comprises eight items, with responses provided on a four-point Likert scale (i.e., not at all, a little, enough, a lot). High CME scores suggest that children perceive themselves as proficient in the aspects of EI being measured.

The third scale is the maximum performance test (AE scale), designed to assess ability-EI. It includes 30 items divided into eight tasks exploring children's abilities in perceiving, using, understanding, and managing emotions, with two tasks assigned to each branch (Fig. 3). Overall, except for items relating to self-reported emotional problem-solving, all tasks in the AE scale explore emotional abilities as cognitive abilities using performance-based tasks.

The Perception Branch involves tasks related to Face and Image perception. In the Face task, children are tasked with determining to what extent three different drawn children's faces express six basic emotions (joy, fear, sadness, surprise, disgust, and anger) using a 4-point Likert scale ranging from 0 (no) to 3 (yes). Similarly, in the Images task, children are asked to associate the six basic emotions with six different pictures, including three color spots and three black and white shapes.

The Facilitation Branch comprises tasks related to Use and Sensations. In the Use task, children must assess the extent to which the six basic emotions are helpful in three different situations, utilizing a 4-point Likert scale from 0 (no) to 3 (yes). In the Sensation task, children are prompted to determine the extent to which the six basic emotions are associated with six different adjectives referring to physical sensations (e.g., cold, bright, etc.).
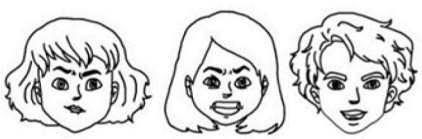
The Understanding of Emotions Branch includes tasks focusing on Blends and Transformations. In the Blends task, children are required to evaluate how effectively the six basic emotions combine to generate three complex emotions (anxiety, jealousy, or nostalgia). In the Transformation task, children are presented with three short stories in two stages, where the emotions of the protagonist evolve following certain events. For each stage, children must indicate to what extent the protagonist might experience the six basic emotions.

The Emotion Management branch consists of tasks focused on Personal Management and Interpersonal Emotion Management. In the Personal Management task, children encounter three short stories where protagonists navigate personal emotional challenges using four possible actions. They must assess the extent to which individuals typically employ each action to manage similar problems and could be effective in resolving the problem. Similarly, the Interpersonal Management task presents three scenarios involving interpersonal emotional challenges. The tasks follow the same format as the Personal Management task but focus on solving interpersonal emotional problems. The two series of answers serve two distinct purposes: 1) revealing the actions children typically adopt in each situation (self-reported emotional problem-solving), encompassing items a-d; 2) identifying which actions children perceive as right or wrong in each scenario (declarative knowledge about emotional problem-solving), covering items e-h. Thus, with the exception of items related to self-reported emotional problem-solving (items a-d of Personal and Interpersonal emotional management tasks), all tasks in the AE scale explore emotional abilities as cognitive abilities, employing performance-based tasks.

Finally, the self-rating about performance scale (AV scale) comprises 8 items prompting children to evaluate their performance in each of the

WHAT EMOTION DOES IT EXPRESS?
PV1

		No	A little	Enough	Yes
1	Joy				
2	Fear				
3	Sadness				
4	Surprise				
5	Disgust				
6	Anger				

(a)

WHAT EMOTION DOES IT EXPRESS?
PI1

		No	A little	Enough	Yes
1	Joy				
2	Fear				
3	Sadness				
4	Surprise				
5	Disgust				
6	Anger				

(b)

ASSOCIATE SENSATIONS WITH EMOTIONS
FS1

COLD

		No	A little	Enough	Yes
1	Joy				
2	Fear				
3	Sadness				
4	Surprise				
5	Disgust				
6	Anger				

(c)

WHAT EMOTION CAN HELP YOU?
FU1

To face a difficult task, it can help…

		No	A little	Enough	Yes
1	Joy				
2	Fear				
3	Sadness				
4	Surprise				
5	Disgust				
6	Anger				

(d)

BLEND THE EMOTIONS
Every emotion is made up of other emotions, indicate which ones:

CM1

	ANXIETY is made up of…				
		No	A little	Enough	Yes
1	Joy				
2	Fear				
3	Sadness				
4	Surprise				
5	Disgust				
6	Anger				

(e)

HOW DO EMOTIONS CHANGE?
CT1

This afternoon you will play with your best friend. How do you feel?

		No	A little	Enough	Yes
1	Joy				
2	Fear				
3	Sadness				
4	Surprise				
5	Disgust				
6	Anger				

Your friend, however, does not come or even tell you. How do you feel now?

		No	A little	Enough	Yes
7	Joy				
8	Fear				
9	Sadness				
10	Surprise				
11	Disgust				
12	Anger				

(f)

Fig. 3. Items drawn from each emotional problem-solving task of the AE test: **(a)** Faces; **(b)** Pictures; **(c)** Sensations; **(d)** Facilitation; **(e)** Blends; **(f)** Changes; **(g)** Emotion Management; **(h)** Emotional Relationships. The items have been translated from Italian to English only for dissemination purposes.

Fig. 3. (*continued*).

Fig. 4. Examples of Face task items drawn from AV scale. The item has been translated from Italian to English only for dissemination purposes.

eight AE-scale tasks (Fig. 4). Children are asked to respond to the question "How did you perform this task?" using a four-point Likert scale ranging from 0 (poorly) to 3 (extremely well). Additionally, each response option is accompanied by visual aids depicting four different facial expressions: sad, neutral, happy, and incredibly happy. This scale allows children to subjectively assess their own performance across various emotional intelligence tasks.

2.3. Procedure

The study was conducted from December 2017 to September 2018 across multiple primary schools located in five Italian cities: Bari, Cagliari, Palermo, Rome, and Turin, during the inaugural implementation of the MetaEmotions at School method (D'Amico & Geraci, 2022b). The IE-ACCME-B test was administered collectively in classrooms by researchers under the supervision of teachers. Upon distributing the test booklets to each student, the administrator orally presented both the instructions and the items to ease comprehension. Throughout the administration session, some students tried independently while others sought guidance from the administrator. Prior informed consent was obtained from the parents of all participating children. The administration occurred in a single session, and nearly all children completed the entire test during this session.

2.4. Data analysis

A preliminary data analysis was conducted on the collected data to detect missing or incomplete data, that were excluded from the final sample. For each item, since respondents are asked to express a judgment on an ordinal scale of categories, such as the Likert scale, Cub models (Piccolo & Simone, 2019) were considered, a class of models developed over the last fifteen years, suitable for the analysis of "ratings data" from responses to items with an intrinsic level of indecision.

The approach considered by the CUB models class treats the respondent's final response as a combination of *Feeling* and *Uncertainty*, allowing to measure the personal feeling/liking for the items under judgment as well as the uncertainty of the respondents in transferring perceptions and emotions into values of an ordinal scale.

From a statistical point of view, the easiest way to formalize the joint effect of *feeling* and *uncertainty* in the rating process consists in considering a mixture of distributions that takes into account the weight of both these components; in particular, the feeling component is modeled by a *translated binomial distribution* (square brackets on the left), while the uncertainty component by a *discrete uniform distribution* (square brackets on the right):

$$Prob\left(R = r|\theta\right) = \pi\left[\binom{m-1}{r-1}(1-\xi)^{r-1}\xi^{m-r}\right] + (1-\pi)\left[\frac{1}{m}\right], \text{with } r = 1, 2,$$

..., *m*, where *m* is the number of ordinal categories (*m* = 4 in our case), ξ and $\pi \in [0,1]$.

The measure of feeling is given by (1-ξ); it can be interpreted as a measure of attraction towards the object to be evaluated. The meaning of *feeling* depends on the specific context of application and is related to the predominance of favorable or unfavorable responses, as the degree of importance, the agreement level, the level of satisfaction, the measure of closeness, the ratings in self-evaluation or the level attributed to a specific variable. The *feeling* manifests the awareness of a true score latent and can be interpreted as agreement with the given statement, such as perception, happiness, and worry. Undoubtedly, for a non-heterogeneous sample of subjects, a distribution with a single mode should occur, positively or negatively asymmetric, as well as symmetric if the evaluations are neutral.

In particular, a value of (1-ξ) close to 0 indicates low *feeling* (most of the respondents choose answers below the central range), a value of (1-ξ) close to 1 indicates high *feeling* (most of the respondents choose answers above the central range), a value of (1-ξ) close to 0.5 indicates moderate *feeling* (most of the respondents choose answers on the central range). Therefore, the feeling expresses in any case a consensus (on no/never, on a little/sometimes, on enough/often, on yes/always, the characteristics of the verbal anchors used in the present study for the four-level of the ordinal scale for each item). Nevertheless, the weight of the consensus depends on the uncertainty. In other words, as the feeling part has a weight equal to π in the mixture (see formula above), the lower the uncertainty, the more marked/accentuated the consensus.

In the *uncertainty* it is possible to identify everything that concerns indecision, a part always presents in any choice. In the *uncertainty* we therefore find all the non-rational components which disturb rational reasoning. The *uncertainty* is the result of possible external factors, such as the time needed to process the application, the limited range of information available, the partial understanding of the question, the laziness of the subject and the desire to joke or give false answers.

The measure of uncertainty is given by (1-π); low values of (1-π), that is values close to 0, indicate low *uncertainty* (many respondents choose the same answer for an item), whereas high values of (1-π), that is values close to 1, indicate high *uncertainty* (respondents divide approximately in four subgroups choosing different answers). It is interesting to note how uncertainty shows the degree of agreement of the respondents: if everyone gives the same vote to a certain item, then this means that the uncertainty is low, otherwise, if the interviewees tend to be equally distributed across the different modalities of the item, this is linked to a high uncertainty.

The uncertainty parameter is crucial since values close to 1 show that the item is not probably clear to the respondent. In the present study, we fixed a value of $\pi > 0.90$ as showing too high and unacceptable uncertainty, while all the values of $\pi < 0.90$ have been considered acceptable, and in particular: low uncertainty $\pi \leq 0.30$; moderate uncertainty $0.30 < \pi < 0.60$; high uncertainty $0.60 \leq \pi < 0.90$.

Uncertainty may assume different meanings depending on the type of tool used. In case of items requiring self-ratings, like in our CME and AV scales, *uncertainty* indicates that the sample is composed of respondents that rate themselves in different ways for a number of possible reasons (their self-image, the awareness of own abilities, the desire to please the interviewer, the moment in which the questionnaire is administered, the fear to demonstrate too high or too low self-consideration, the fear of the consequences that could exist with respect to the answers, and so on).

In the case of items asking to rate specific statements or stimuli, like in our CE and AE scales, *uncertainty* shows that respondents do not agree each other's on a specific answer or that, in other words, there is a limited consensus for certain answers. This can occur for different reasons: the items could not be particularly clear for some respondents, the item is too difficult for some of them, participants have a different level of ability for the required task, and much more.

CUB models have been adapted on data for CE, CME, AE and AV scales by using the R package CUB (Iannario et al., 2020). Results obtained by adapting a CUB model without covariates to the responses of each item in each scale are first presented, then we proceeded by adapting a CUB model with covariates to each item of both questionnaires, where the sex variable explains the feeling parameter, keeping the uncertainty constant, and vice-versa, with the aim of identifying if there are sex differences in feeling/uncertainty of answers. In other words, we indagated if males and females tend to give different answers to the various items, as usually happens starting from pre-adolescence.

3. Results

Tables presented as supplementary materials report response frequency distribution and feeling and uncertainty values for all items of IE-ACCME-B test.

3.1. CUB model for the CE questionnaire

Results showed that most of the items have a feeling parameter >0.5 and a low uncertainty (< 0.5) which indicates that children tend to give positive responses ("Enough", "A lot") to these questions and that most of the sample tend to converge on the same answers. Only the items CE-FS and CE-CM have a feeling lower than 0.5, indicating that the respondents tend to give negative answers ("No", "A little"), and high uncertainty (CE-FS = 0.57, CE-CM = 0.92), indicating that, however, in both items there also is a consistent number of children that chose also "Enough" and "Yes". In particular, the percentages of children that chose each answer for item CE-FS are: "No" = 22 %; "A little" = 35 %; "Enough" = 25 %; "Yes" = 18 %, and for the item CE-CM: "No" = 31 %; "A little" = 23 %; "Enough" = 25 %; "Yes" = 22 %. Furthermore, it can be noted how the negative asymmetry of the distribution of item CE-CM is less marked than that of item CE-CF, since item CE-CM has a higher uncertainty than item CE-CF. This item should be paid attention to as its uncertainty exceeds the threshold value.

3.2. CUB model for the CME scale

In CME scale all items show positive feeling, and the model with the greatest feeling (1-ξ = 0.79) is CME-GI (emotional relationships). All items show also low uncertainty except for the item referring to sensations (CME-FS: 1-π = 0.65) and emotional blends (CME-CM: 1-π = 0.67) that obtain high uncertainty values.

3.3. CUB model for the AV scale

All the models have a feeling parameter (1-ξ) >0.70 and an uncertainty (1-π) parameter lower than 0.10, denoting a right-skewed distribution with high concentration of children tending to give positive responses ("Enough", "A lot").

3.4. CUB model for the AE test

Due to the high numbers of items in AE test, the results have been organized in four tables, one for each of the four branches of IE model, and are presented as supplementary materials.

Regarding the Perception of emotions: for the Faces task (PV), the items with greatest feeling are PV1_4, PV2_6 and PV3_3 (1-ξ > 0.9), whereas only the item PV1_2 overcome the threshold of uncertainty (1-π = 0.97), indicating that children are almost equally distributed across the four modalities ("No" = 25 %; "A little" = 26 %; "Enough" = 23 %; "Yes" = 25 %); for the Images task (PI), the items with greatest feeling are PI1_1, PI2_2 and PI4_2 (1-ξ close to 1.00). On the contrary, the items with the greatest uncertainty are PI2_2, PI2_6, PI4_2, PI4_3, PI6_4, and the items PI1_4, PI2_2, PI5_1 overcome the threshold of uncertainty, showing again that children are almost equally distributed across the four modalities.

Regarding the Facilitation of Thinking branch: for the Use task (FU), the greatest feeling is shown by the items FU2_6 and FU3_1 (1-ξ close to 1.00), while the item with highest value of uncertainty is the FU1_1 (1-π = 0.86), but none of the items overcome the threshold; for the Sensation task (FS), the greatest feeling is shown by the items FS3_1, FS4_2 and FS5_1 (1-ξ close to 1.00), whereas the item FS4_2 show great uncertainty and FS5_1 overcome the threshold of uncertainty.

Regarding the Understanding of Emotion branch: for the Blend task (CM), results show high feeling for the item CM1_2, CM2_6 (1-ξ close to 1.00), and CM3_3 (1-ξ > 0.90), while the item CM2_3 show high uncertainty without exceeding the threshold; for the Changes task (CT), the models with greatest feeling are CT1_1, CT1_9, CT1_12, CT2_6, CT2_7, CT2_10, CT3_9, and CT3_12 (1-ξ close to 0.98), and those with high uncertainty are CT1_4, CT2_10 and CT3_1, with CT1_4 overcoming the threshold value.

Lastly, regarding the Management of Emotions branch: for the

Personal Emotional Management (GP), the items showing a high uncertainty are GP1_b, GP1_f, GP1_h, but none of them exceed the cut-off; for the Interpersonal Emotional Management task (GI), the items showing high uncertainty are GI1_f, GI2_e, GI2_h, GI3_a, GI3_e, and the only one overcoming the cut-off is GI2_d.

3.5. CUB models with sex as covariate

Figures and Tables related to the Feeling and Uncertainty estimates by sex are not reported as the models obtained almost overlap for each item of CE, CME, AE and AV scales, showing no statistically significant difference between males and females. It can therefore be said that the expected responses to the distinct items are independent of sex.

4. Discussion

Results obtained in the different IE-ACCME-B scales are quite heterogeneous. Considering CE scale, most of the CUB models performed have acceptable feeling parameters and a limited uncertainty. Positive feeling parameters confirms a prevalence of positive responses to the distinct items and that the respondents are agree on the importance of emotions in everyday life situations. Regarding uncertainty, the item exploring the relationship between sensations and emotions ("can the taste or the smell make you emotional") have a high uncertainty compared to the other questions, suggesting that beliefs of children about such statements may not be homogenous: some subgroups might associate physical sensation to emotions and some other do not. Similarly for the items about emotional blends ("In your opinion, is it possible to experience many emotions all together?"), the answers are very uncertain, also overcoming the cutoff level. Thus, this item could be removed from the final version since it is not highly informative for children of this age level, probably they did not fully understand the meaning of the sentences, or they actually have a cognition and experience of emotions as more discrete and less blended.

For the CME scale, high levels of feelings for all items show that, in general, individuals evaluate positively their emotional abilities in all 8 dimensions of emotional intelligence. As for the uncertainty levels, all items show low uncertainty except for the item referring to sensations ("are you good at understanding what emotion can be conveyed by a taste or a flavor?") and emotional blends ("are you good at understanding all the emotions you feel at the same time?") suggesting that some subgroups may have difficulties in associating physical sensation with emotions and understanding complex emotions or interpreting emotional blends.

It is interesting to note, therefore, that the items that show the highest levels of uncertainty in both the CE and CME scales are those related to emotional sensations and blending of emotions. This is probably since these are two quite complex dimensions of emotional life for children of this age: understanding the relationship between sensations and emotions implies a high degree of awareness and attention to one's own physiological state and how it influences and is influenced by emotional state. Children often overlap physical discomfort with emotional discomfort (e.g., complaining of stomachache when they are afraid or sad) but, as these results seem to show, they often do not have great awareness of this association. In relation to emotional blends, some literature also shows that complex emotions, those that stand for a combination of other emotions, are recognized secondarily to primary emotions, and therefore even in this case it is legitimate to think that these results show a lack of knowledge of the different mixtures of emotions that a complex emotion can involve.

Concerning the AE test, as shown by feelings and uncertainty scores obtained, the sample of children involved in the study provided answers in line with the theoretical expectations of the IE-ACCME-B author, showing that the different subtests and the most part of related items measure what they are intended to measure. At the same time, the examination of uncertainty parameters showed that, for children of this

age, some items of just some answers of the test may be not highly informative and may be eliminated or not computed in the final version of the test. Indeed, in some items each answer has almost the same probability to be chosen; when frequency score will be used as consensus scores, these items or answers will not allow to discriminate among children that make different choices.

In particular, in the three items of the Face task (PV), the items 1, 2 and 3 that have surprise, anger and sadness as their target emotion were correctly identified by the majority of children without uncertainty, but for item 1 indicating surprise, many children's responses focused also on different levels of "fear", even if percentage of answers are so similar each other (see results section) that whatever is the answer given by children they will gain the same result.

In the Images task (PI), similarly, the answers of children in three out of six items agree on assigning emotion to colors, and their answers almost correspond to the hypotheses developed (D'Amico, 2013) during test development. For the item 1 representing the color yellow they all choose high level of "joy" (high feeling and low uncertainty) and some subgroups also chose "surprise" (even if with high levels of uncertainty); in the item 4 representing the purple color most of them chose high level of "fear" (high feeling but high uncertainty) and a little bit of "sadness" (low feeling and high uncertainty). For the item 5 being the green color, there were no answer reaching good levels of feeling, even if the answers of "surprise" and "disgust" produced moderate levels of uncertainty, indicating that some children associated these emotions to the color green.

The answers of children in three out of six items agree on assigning emotion to shapes, for the items 2 representing a shape similar to a lightning some of them chose high level of "fear" and someone else "anger", even in both cases there was an high level of uncertainty; for item 3 representing round shapes none of the emotions received an high level of feeling, and for surprise resulted a moderate level of uncertainty; similarly, for and item 6 representing a shape similar to an explosion none of the emotions received an high level of feeling, even if there is a high level of uncertainty for "surprise".

For the Use task (FU) results show that all emotional answers of item 1 ("What emotion can help you to face a difficult task?"), obtain low level of feeling. This probably shows that children in this sample and in this age group are not aware the emotions may be useful for facilitating thinking and this task is particular difficult for them, that is a result also confirmed during validation of IE-ACCME test for adolescents (D'Amico, 2013). However, high levels of uncertainty for the emotions "Joy" and "surprise" in this item shows that there is also a subgroup of children that started to develop this kind of awareness and that consider pleasant and energetic emotions as a way for facilitating an effortful task and for improving self-motivation. For Item 2 and 3 on the contrary, the most of children gave well definite answer, choosing respectively "anger" (high feeling and moderate uncertainty) as the helping emotion for defending themselves against an overbearing person, and some subgroup also chose a little bit of "fear" (moderate uncertainty). In Item 3, then, "joy" (high feeling and moderate uncertainty) was chosen for "comforting a very sad friend". Both answers reflect a "children perspective" about useful emotions that is not completely mature but is in the right direction. Indeed, considering item 2, we know that in copy with bulls we need the energy and desire to revenge that is an aspect of anger and at the same time, the circumspection of fear. Considering item 3, similarly, it is true that for comforting a sad friend, we need the energy and pleasantness of joy but also a certain amount of sadness, in order to generate empathy towards that friend and confirming his/her emotions.

As for the Sensation task (FS), results show that only three out of six items reporting sensations are correctly associated to emotions. This is the case for the item 3, where "bright" is associated to joy (high feeling and moderate uncertainty), but for some children also to "surprise". Similarly, the sensation "stinging" is associated to high level of fear, and some children associate to it also a little bit of sadness. In item 5, sensation "lightweight" is highly associated to "joy" (with high feelings

and low uncertainty). For the remaining three items of this task (1, 2 and 6) having respectively "cold", "salty" and "acute" as words referring to sensations, there is not a clear pattern of association with emotions. This probably suggest that these items are not very emotionally meaningful for children of this age. To this respect, we should remember that even in items of CE and CME scales referring to association between emotion and sensation children reported results revealing low feeling and high uncertainty, showing that children, as many adults, are not fully aware of the connection between sensations and emotions.

In the Blends task (CM), all the three items were associated to an emotion with high levers of feeling and low level of uncertainty: anxiety (item1) was associated to fear, jealousy (item 2) with anger, and nostalgia (item 3) with sadness. In the case of anxiety and jealousy, some children in the sample also associated a little bit of sadness to these emotions. These answers may be considered acceptable but not really mature, since the concept underlying the blending of emotion foresees that those complex emotional states result from a combination of more than one simple emotion. Even in this case, however, these results confirm what already discussed for the items exploring the same dimension in CE and CME scales.

As for the Changes task (CT), in all the three item used children seems able to understand how emotions may change in response to different situations, and results reveal that the level of feeling and un-certainty for each answer change considerably in different situations. In Item 1, children agree (with high levels of feeling and low uncertainty) that a disappointed expectation from a friend can turn joy in sadness and anger. Similarly, in item 2 children agree (with high levels of feeling and low uncertainty) that a friend's restorative behavior can turn the initial sadness and anger into joy and surprise. Finally, in item 3 children agree that the betrayal of a friend may produce high level of sadness and anger and for some children also a little bit of fear and surprise.

In Tasks about the personal and interpersonal management of emo-tions, as already described, the two series of answers are used since they give us two different pieces of information: 1) which actions children think are right and wrong in each situation (declarative knowledge about solving emotional problem); 2) which actions children refer to adopt in each situation (self-reported emotional problem solving). Concerning the Personal Emotional Management task (GP), in item 1 asking "What do you do/what should you do when you are very angry" children show great uncertainty in the first set of answers (What do you do) demonstrating that they use different emotional strategies, and none of the answers reach very high level of feeling. On the contrary, high level of feeling result in the second set of answers (what should you do) and in particular for "Trying to reflect on the things that made me angry" and "Setting out to play and do not think about it". However, these answers are accompanied by higher level of uncertainty showing also that children do not have yet a shared idea about the best ways to manage emotions. In item 2, "What do you do/what should you do when you think there are better children than you" the first set and the second set of answers seem to overlap indicating that children as chose as the best strategy to "Try to improve oneself" that is also the way they report to adopt for themselves. In item 3, asking "What do you do/what should you do when you are sad", children again show a general overlapping among what they report to do and they think is should be done, since in both series of answers they choose "Trying to do something fun" and "Thinking about how I can change things". Interestingly, they are also coherent in saying that they do not cry when they are sad and that "getting to cry is not what you should do.

As for the Interpersonal Emotional Management task (GI), in the first item asking "What do you do/what should you do when you feel guilty toward someone" the children are consistent in saying that they/they should "Try to apologize and do better next time" and that they do not/ they should not "avoid that person". In item 2, asking "What do you do/ what should you do when you want something very much, but your parents don't want to please you" the higher feeling for both series of answers is towards "Trying to explain why it is so important to me", but

there is also a high level of uncertainty. Interestingly they seem again more aware about what is better not do to, and the lower level of feeling with low uncertainty are for "get angry when your parents don't want to give you something you desire". For item 3, finally, at the question "What do you do/what should you do when someone you care about hurts you" the answers that receive the higher level of feeling and the lower level of uncertainty are about the necessity to "try to make him/ her understand how I feel".

In general, results in Emotional Management tasks seem to demon-strates that; children are more certain about the worst strategies to manage emotions (what you should *not* to do) than about the best ones; in children's answers emerge the tendency to suppress emotions, since they affirm that to "shout, slam my fits or cry" is something that they do not use and that should not be used; the answers referring to self-reported strategies (What do you do) and declarative knowledge about management of emotions (what should you do) are frequently over-lapping. Thus, children in situations similar to those exemplified say that they generally engage in the same behaviors that they believe to be correct. This is quite different from results obtained in adolescents (D'Amico, 2013), where a certain discrepancy between the two sections of the test were found.

The latest results refer to the self-rating about performance scale (AV). In this case, all items show high feeling and low uncertainty, indicating that children consistently believe they performed well on each task of the emotional abilities test. Since self-evaluation of per-formance is a key aspect of metacognition, these results are consistent with studies that show how children exhibit a bias towards over-confidence in their knowledge which tends to decrease over time, in particular around age 12 (Roebers et al., 2007; Smortchkova & Shea, 2020; van Loon et al., 2013). Actually, this tendency to decrease with age the self-evaluation of performance was observed also in results of IE-ACCME for adolescents (D'Amico, 2013; D'Amico & Geraci, 2022a).

Concerning sex difference in the answer to IE-ACCME_B, no statis-tically significant sex difference has been found in children answers which is consistent with those studies showing that sex differences in emotion expression are moderated by age, and usually arise during preadolescence and adolescence (see Chaplin & Aldao, 2013).

5. Conclusions

As stated elsewhere MEI is a new construct that has already provided new and innovative insights into EI research in adolescents, allowing to study and measure the cognitive and metacognitive aspects of emotional processing. It is particularly important to use the same theoretical and methodological framework also for younger children, for studying emotional and metaemotional abilities under a developmental and life-cycle point of view. Even if this study involved only fourth grade chil-dren and is only aimed to the item analysis of IE-ACCME-B test, just the first step in the validation and standardization process, obtained results show that it is promising tool to investigate emotional and metaemo-tional intelligence in children and first interesting results emerged from the quantitative-qualitative analyses of the answers.

In general, results demonstrated that the most of items included in the test are not too simple nor too difficult to answer for this age level. For CE and CME positive feeling show that children have in general great importance to emotion in everyday life and that they own a positive self-concept about their own emotional abilities in everyday life. The an-swers at the AE test are useful for building the consensus score since they are at the same time concentrated on the expected answers, but also enough distributed across the other answers, for giving more variability to the test and allowing to capture slight individual differences. We discussed that some answers overcame the threshold for uncertainty and their inclusion in final scoring may be not informative. However, we are also curious to investigate what can happen with younger or older children. Probably, the fact that in this sample some items received uncertain answers simply indicate that children are developing a vision

increasingly multifaceted of emotions, passing from a more discrete cognition of emotions to a more continuous one.

Only future studies, actually undergoing, aimed at enlarging the actual standardization sample with younger and older children will allow us to confirm this hypothesis. Then, we will be also able to refine the tool and apply more sophisticated validation analyses to obtain overall scores in distinct aspects of emotional and metaemotional intelligence in the different age groups. As stated above, IE-ACCME-B test is an opensource test and scholars from all over the world interested in translating and validating it in their countries are welcome.

CRediT authorship contribution statement

Antonella D'Amico: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Mariantonietta Ruggieri:** Data curation, Formal analysis, Methodology, Software, Supervision, Validation, Writing – original draft, Writing – review & editing. **Alessandro Geraci:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing, Formal analysis.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2024.112676.

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